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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/626,550

07/25/2003

Se-Yeul Bae

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9321

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7590

04/28/2005

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EXAMINER

MALSAWMA, LALRINFAMKIM HMAR

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 04/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

EV

Office Action Summary	Application No.		Applicant(s)	
	10/626,550		BAE, SE-YEUL	
	Examiner		Art Unit	
	Lex Malsawma		2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 5-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 5-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 12, 2005 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1 and 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Aoki** (6,387,821) in view of Han et al. (6,281,135 B1; hereinafter, "**Han**").

Regarding claims 1 and 5-8:

Aoki discloses (in Figs. 1-4 and Col. 8, lines 18-65) a method of forming metal wiring in a semiconductor device comprising:

forming a bottom metal pattern 105 on a semiconductor substrate (Col. 8, lines 4-5);

forming a low-temperature oxide (HSQ) an insulating layer 106 on the semiconductor substrate including the bottom metal pattern, wherein the low-temperature oxide (HSQ) is

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formed at the temperature of 400 °C (Col. 8, lines 26-28) and having a thickness of 1200 nm (12000 angstroms);

forming a first photoresist pattern 107 (Fig. 2a) for forming via hole on the low temperature oxide 106;

forming an unfinished via hole by removing the low temperature oxide selectively for a prescribed thickness using the first photoresist pattern as a mask (Fig. 2b), wherein the unfinished via hole is formed to make the thickness of the insulating layer 106 remaining inside the via hole equal to the thickness of the upper part of the damascene contact (i.e., the thickness of remaining insulating layer 106 below the unfinished via in Fig. 3a is equal to the thickness of the upper part of the damascene opening in Fig. 3b);

removing the first photoresist pattern 107 (Figs. 2a-2b);

forming a second photoresist pattern 108 for forming damascene pattern on the low temperature oxide around the unfinished via hole (Fig. 3a);

forming a damascene pattern by removing the low temperature oxide 106 selectively using the second photoresist pattern as a mask (Fig. 3b);,

removing the second photoresist pattern 108 (Figs. 3a-3b); and

forming a metal-wiring-via-damascene contact 111 by filling metal 111 (copper) in the damascene pattern, wherein the damascene contact is formed by dry deposition (i.e., sputtering) of metal on the insulating layer including the damascene pattern and the planarizing the metal 111 by CMP process (Figs. 4a-4b and Col. 8, lines 58-65).

Aoki **lacks** the thickness of the insulating film 106 remaining inside the unfinished via hole being specifically less than the thickness of the upper part of the damascene contact.

However, it is important to note that, although Aoki discloses/shows “equal thickness” in Figs. 3a-3b, Aoki does not limit the relationship (in thickness) between the remaining film inside the via and the upper part, i.e., Aoki does not require the two regions to have equal thickness (or any other thickness relationship).

Han is **cited primarily to show** a process, similar to that disclosed by Aoki, for forming a dual damascene contact within a low-k dielectric layer 14 (Fig. 1C-1L), where the process includes the steps of forming an unfinished via hole wherein a thickness of the low-k material remaining inside/under the unfinished via hole is less than a thickness of an upper part of damascene contact (note Fig. 1E-1F). Note Han discloses (in Col. 5, lines 32-33) that the low-k material includes hydrogen silsesquioxane (HSQ), i.e., both Aoki and Han disclose forming a dual damascene contact utilizing similar process steps and materials.

Given Han’s disclosure and the fact that Aoki does not require “equal thickness” between the two regions, *it would have been obvious* to one of ordinary skill in the art to modify Aoki by specifically forming the insulating film 106 remaining inside the unfinished via hole to have a thickness less than that of the upper part of the damascene contact *because* Han shows that, when a dual damascene contact is formed utilizing process-and-material that are essentially the same as in Aoki, the “thickness relationship” (recited within the current invention) is readily attainable without any notable/significant changes to the process (i.e., Aoki’s process). In other words, given Han’s disclosure, one of ordinary skill in the art would have readily recognized that no significant/essential modification of Aoki would be necessary to arrive at the currently claimed invention; accordingly, the currently claimed invention is considered to be an obvious

modification of Aoki that would have been readily recognized by one of ordinary skill in the art, especially in view of Han's disclosure.

Remarks

4. Applicant's remarks/arguments have been carefully reviewed and considered, but they are not persuasive for the following reasons. Applicant asserts that Aoki's HSQ layer (106) is not a low temperature oxide and provided U.S. Pat. No. 5,981,354 ("Spikes") to show that HSQ is a flowable oxide that is deposited then heated, and applicant submits that a flowable oxide is not a low temperature oxide. The current specification has been thoroughly reviewed in order to determine what the applicant considers to be (or specifies to be) a low temperature oxide. On page 4, in lines 8-9, the only description for what seems to be applicant's definition for a low temperature oxide is provided, wherein the low temperature oxide is described as "[a]n oxide formed in a furnace with a low temperature, preferably 150~500°C...". Such a description (or specification) for a low temperature oxide cannot exclude HSQ from being considered to be a low temperature oxide, especially because all processing temperatures for the HSQ film (disclosed by Aoki), including the step heat treating process (150 °C, 200 °C and 350 °C) and the additional heat treatment at 400 °C, fall exactly within the temperature range that is preferred for a low temperature oxide (according to the current specification). As stated in a prior Office Action, Aoki specifically recites (in Col. 8, lines 26-28), "heat treatment was conducted... at 400 °C for 60 minutes to form a HSQ film 106". In other words, all the heat treating processes performed by Aoki are necessary to form the HSQ film (106); and according to the current specification, Aoki's HSQ film is certainly an oxide that is formed with a low temperature,

preferably within the range of 150~500°C; therefore, Aoki's HSQ film is a low temperature oxide by applicant's own description. In reference to the remarks/arguments regarding the thickness relationship between the remaining oxide and the upper part of the damascene contact, this feature of the claimed invention has been addressed in detail above.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Liu (6,346,474 B1) is cited to show another dual damascene process similar to that of the current invention, wherein the process utilizes low-k materials including HSQ.


Spikes (5,981,354) was submitted by the applicant and is has been considered and made of record.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is 571-272-1903.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Lex Malsawma 

April 26, 2005